International Journal of Control and Automation
Vol. 13, No. 2s, (2020), pp. 129-150

Distribution Network Reconfiguration for Loss Reduction Methodology: A Review

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Abstract

A Distribution System Operator (DSO) who operates and develops distribution networks to deliver quality and reliable power to consumers at an affordable price with the support of system optimization. Power losses are indicative of the cost-effective operation and quality of the DSO's activities. DSO has a distribution system comprising network, demand, generation and other flexible distributed energy resources (DER). Reduction of power loss is one of the most important business objectives of the DSO. Distribution Network Reconfiguration (DNR) or Feeder Reconfiguration (FR) is the most efficient methodology adapted by DSOs for loss reduction. DNR is a complex combinatorial optimization process aimed at finding a radial operating structure that minimizes the system power loss while satisfying operating constraints. This paper gives the brief review from the literature on DNR methodology with objective function, methods of optimization, features of optimizations, test system and contribution with results.

Keywords: Distribution systems, Distribution Network Reconfiguration, Loss Reduction, Network Reconfiguration, Feeder Reconfiguration

1. Introduction

Electrical grid is an interconnected network for delivering electricity from suppliers to consumers. It consists of generating stations that produce electrical power, high-voltage transmission lines that carry power from distant sources to demand centers, and distribution lines that connect individual customers. In electrical power business, Transmission System Operator (TSO) is one who transmits electrical power from generation stations to local electricity distribution operators through his own transmission network. DSO or DISCOM (Distribution Company) should have license to distribute the power through his own network to various categories of consumers in the area at a tariff fixed by the electricity regulatory commission and responsible for power purchase and sold. DSO has to maintain quality and reliable power to his consumers. The DSO has to design the power distribution system, such as to timely meet the demand growth in the most economical, reliable, and safe way.Hence to run the system in most optimal way DSO always try to reduce the distribution network losses. For minimization of losses, most popular methodologies generally followed by the DSOs for radial distribution networks are:

1. Network Reconfiguration
2. Capacitor placement
3. Distribution generation

The above methods are implemented either individual or combination of two or three. The results will be more effective if we use the methods applied simultaneously. Load balancing and higher voltage level distribution are other techniques which are not focused in our study. Brief literature review has been carried on reconfiguration of distribution network focusing on objective function, optimization method and test system applied, comparison of result and contribution of work. The details are tabulated in Table.1. Entire review has divided into four sections named as sections A,sections B,sections C,sections D, which emphases on DNR, DNR with optimal capacitor size and placement,DNR with optimal DG size and placement and DNR with optimal capacitor and DG size and placement respectively.

ISSN: 2005-4297 IJCA

The remaining sections are organized as section 2 describes with distribution network reconfiguration, section 3 deals DNR with capacitor size and placement, DNR withDG size and placement separately. Section4 explains about DNR with capacitor and DGs size and placement together. Section 5 discussion and recommendations followed by conclusions in section 6.

2. Distribution Network Reconfiguration

Two types of switches are used in primary distribution systems. There are normally closed switches (sectionalizing switches) and normally open switches (tie switches). Those two types of switches are designed for both protection and configuration management. Network reconfiguration is the process of changing the topology of distribution systems by changing the open/close status of switches. The primary aim of reconfiguring the distribution system lies both in reducing power loss and in enhancing the system security through load balance during normal operations. The load of the feeder can be transferred as a result of altering the open/close status of the switches. However, there are numerous switches in a typical distribution system and the number of possible switching operations is tremendous. Therefore, a good strategy in the switching operation scheme is needed to carry out the goals of reducing real power loss and enhancing the system security through load balance.

2.1 Objectives of DNR

The discrete nature of the switch values and radiality constraint prevent the use of classical optimization techniques to solve the DNR problem. Therefore, most of the algorithms in the literature are based on heuristic search techniques, using either analytical or knowledge-based engines.The distribution network is reconfigured with the following objectives:

1. Reducing power losses
2. Relieving overload (balance loading)
3. Reducing voltage deviations
4. Restoring the system one important area in which distribution automation is being applied is the area of network reconfiguration

The optimization procedure is subject to some technical (maximum permissible branch current, maximum and minimum voltage limits and maximum permissible size of capacitors) and operational constraints (load connectivity and radial network structure).Objective function to be minimized is the powerloss(PLOSS) can be mathematically given as below

$$\min(\mathrm{PLOSS}) = \min\left(\mathrm{real}\left[\sum_{k=1}^{NL}(S_{k,ij} + S_{k,ji})\right]\right) \quad (1)$$

Subject to

$$\mathrm{PGi} - \mathrm{PDi} - \sum_{j=1}^{n} \mathrm{PLOSSij} = 0 \quad (2)$$

$$\mathrm{QGi} - \mathrm{QDi} - \sum_{j=1}^{n} \mathrm{QLOSSij} = 0 \quad (3)$$

$$\mathrm{Vmin,i} \le \mathrm{Vi} \le \mathrm{Vmax,i} \quad (4)$$

$$\mathrm{PGi} \le \mathrm{PGmax,i} \quad (5)$$

Where PGi is the real power generation at bus ‘i'
PDi is the real load in bus ‘i’
PLOSSijis the active power loss in the line ij
QGiis the reactive power generation at bus ‘i’
QDiis the reactive load in bus ‘i’
QLOSSijis the reactive power loss in the line ij
Viis the voltage at bus ‘i’
Vmin, i is the minimum and maximum voltage limits at bus ‘i’

ISSN: 2005-4297 IJCA

$V_{max,i}$ is the maximum voltage limits at bus 'i'
Sij is the apparent power flow in the line ij
$S_{k,ij}$ is the complex power flowing from bus 'i' to 'j'
$S_{k,ji}$ is the complex power flowing from bus 'j' to 'i'
$PG_{max,i}$ is the maximum real power generation available at bus 'i'
NG is the total number of generators
NL is the total number of network lines

2.2 Algorithm of DNR

The discrete nature of the switch values and radiality constraint prevent the use of classical optimization techniques to solve the DNR problem. Most of the algorithms in the literature are based on heuristic search techniques, using either analytical or knowledge-based engines. The step by step algorithm of DNR

*Step 1:*Read the system data i.e feeder data, line data, number of line and tie switches etc. of the distribution system

*Step 2:*Note down the initial status of sectionalizing and tie switches

*Step 3:*Perform the load flow analysis on the given distribution network

*Step 4:*Calculate the node voltages and branch currents and power loss of the given network

*Step 5:*Change of the state of section alizing and tie switches in the distribution network using any optimization algorithm

*Step 6:*Check the criteria for reconfiguration, if no repeat the the*Step 2* with new status of sectionalizing and tie switches or move to *Step 7*

*Step 7:*Print the output the positions (ON/OFF) of all the switches, which gives the optimal reconfigured network and optimal sizing and placement of capacitors while minimizing the losses.

2.3 DNR in the Literature[1-30]

DNR is a discrete and non-linear nature of the optimization problem. From the literature survey single objective function[2-8,11-13,20-23,27,28,30-32] is either minimization of real power loss or maximization of reduction of total power lossin the network. The multi objective function [1,6,9,10,14-19,24-26,29] are tabulated in Table.1.In the table it is clearly mentioned that methods of optimization, features of optimizations, test system and contribution with results. Cost of supply [1,14,32], Line laudability[8]reliability[15,18,29], voltage deviation index[16,1725] protection constraints[24] are also considered as part of objective function. Several nontraditional optimization techniques are applied to solve the single or multi objective optimization problems. The comparison of results with other algorithms is listed in Table.1. MATLAB is general software used for most of the simulations. All the proposed algorithms are tested on standard radial bus system and practice network like Taiwan Power Company and distribution network in Croatia. The contribution of work is also incorporated in the Table.1

BGA method is proposed to investigate the optimal configuration to deregulated distribution networks and reduced the total energy supply cost with adaptive mutation and power losses [1].Heuristic technique has simple rules and two parts; one determines best witching combinations and other calculates power loss [2].In heuristic approach of optimal tree structure of RDS indeed identifies the connectivity of the nodes and branches and formation of the loop for reducing resistive line losses, and reliving overloads [3]. In PGSA-Greedy heuristic fuzzy optimization algorithm network constraints are incorporated to maintaining branches current loading within the limit, buses voltage within the limit by which line loss reduction and load balance can be achieved [4]. In [5] meta-heuristic method MTS algorithm which is modification of TS algorithm in variable size and a random multiplicative move is used in the search process.In fuzzy adaptive particle swarm optimization includes two parts. The first part is fuzzy adaptive binary particle swarm optimization, which determines the status of tie switches, and the second part is fuzzy adaptive discrete particle swarm optimization, which determines the sectionalizing switch number [6].Convergence rate curve confirms that the method HSA which is conceptualized using the musical process of searching for a perfect state of harmony can more efficiently search the optimal or near-optimal solution for network reconfiguration problems [7].In [8] proposed algorithm is based on simple heuristic rules identifies effective switch status configuration of distribution system for maximizing LLI. Unlike conventional DNR the proposed approach EGSA considers reliability, operation cost of generation of power, and power loss simultaneously as objective function [9]. NSGA II is used to solve the multi objective optimization problem with intention to reduce total losses in the network and improve system reliability through minimization of total costs incurred due to power supply interruptions [10].

Ant colony system algorithm which perform search in parallel for good solutions and has characteristics like Positive feedback, Distributed computation, Greedy heuristic which makes best suitable method for network reconfiguration so as to minimize power losses [11].In [12] the status of the switches is obtained by using Artificial Bee Colony algorithm which has three stages, stage one find the tie switches stage two the identifies tie switches and are checked for radiality if satisfied proceeds to third stage where load flow analysis is performed.The catfish PSO algorithm was proposed to configure the distribution network to keep the load balance so that the power loss was minimum and highly suitable technique to use in service restoration procedures[13]. A new stochastic framework, based on PEM and MCSA is proposed to investigate the constructive consequence of optimal reconfiguration on the reliability of the distribution systems including SAIFI, SAIDI and AENS and total active power [14]. Under abnormal conditions, the proposed method swarm intelligence based global optimization process FWA, will isolate the faulted areas and assures power supply to the non-faulted areas of the system with minimum voltage deviation and load shedding [15]. Radial topology of the network is maintained based on the movement of each load node to the set of power nodes when it is connected to a node in the set of power nodes in the proposed CSA population-based heuristic evolutionary algorithm [16]. The network reconfiguration problem for loss reduction and reliability improvement is formulated to be solved by using enhanced GA [17]. Non-dominated sorting technique is added to ACO which forms multi-objective optimization problem applied for DNR where the two objective functions are real power loss and ENS index [18]. BFOA is used as the optimal solution to non-linear optimization problem of DNR with an objective of loss minimization [19].In [20] BFOA is proposed along with BFS and GIS to minimize the real power loss through reconfiguration and improving the voltage profile of the distribution network.

Due to high R/X ratio of distribution network, convergence problems occurred while load flow analysis is carried out with Newton Raphson method, BBO gives best solution which is slightly inferior to best solution of HAS [21].A Meta-heuristic Particle swarm optimization is used to reconfigure and recognize the optimal tie switches for reduction of real power loss in a radial distribution system where the constraints of voltage and branch current carrying capacity are incorporated in the assessment of the objective function [22].Protective constraints consist of operating constraints of the relays, reclosers and fuses of the distribution network in the normal and fault conditions are considered in reconfiguration problem [23].A hybrid PSO searching algorithm has strong search ability by introducing NRK as the tree representation strategy because NRK is not very sensitive to PSO algorithm [24].The Dragonfly algorithm starts optimization process by creating a set of random solutions for a given optimization problem. In each iteration, the position and step of each dragonfly are updated and the position updating process is continued iteratively until the convergence criterion is satisfied [25].In [26] the application of an NMPC algorithm for dynamic reconfiguration of power distribution systems on a case study of a real-life power distribution grid in Croatia.
A multi-objective framework is proposed for optimal network reconfiguration with objective functions of minimization of power losses and reliability indices under ICA fuzzy frame work [27]. MPSO algorithm has filtered random selective search space for initial position, which is proposed to accelerate the algorithm for reaching the optimum solution [28].
The network active power loss is picked as the minimization problem and it is diminished by executing optimum feeder reconfiguration in radial power distribution system using unified particle swarm optimization algorithm [29].An efficient Multi Verse Optimization (MVO) technique has executed successfully for the reconfiguration problem in the distribution network and the main

ISSN: 2005-4297 IJCA

advantage of the proposed MVO technique is the less computational to converge the optimum solution when compared with all other optimization techniques [30].

3. DNR with Capacitor and DNR with DG

3.1 Objectives

In electrical network system Capacitor banks serve different purposes. Capacitor can be installed in the system without any reconfiguration also. But it is fore effective when it is placed simultaneously with the DNR. Summarizing the benefits of capacitor is as follows.

1. Compensate the reactive power
2. Enhancing network loading capacity
3. Decrease in network losses
4. Enhancement in the Power factor
5. Steady-state voltage profile correction

While a capacitor bank can provide all the above mentioned influences simultaneously, but the size and location of the capacitor bank depends on the main objective function, in form of one or several of the above-mentioned benefits. The capacitors are effectively reducing power losses by compensating for the reactive power and hence lowering the current from the generators to the capacitor bank. Hence, capacitor banks are able to reduce power losses as well as the network lines loading. Accordingly, capacitor placement and network reconfiguration are suitable measures to reduce losses in the distribution networks. The objective function is same but additional constraint for placing capacitor is as follows

Size of installed capacitor constraint (the total reactive power injection Qs is not to exceed the total reactive power demand Qd in the distribution system

$$\mathrm{Qs} \leq \mathrm{Qd} \quad (6)$$

The conventional power distribution systems have radial networks with unidirectional power flows. With the advent of DGs, however, power distribution systems would have locally looped networks with bidirectional power flows. The problems of power system operations and planning schemes will be arising due to the increase of distribution generation units to the distribution power systems.DG units are integrated in distribution network to improve voltage profile, to provide reliable and uninterrupted power supply and also to achieve economic benefits such as minimum power loss, energy efficiency and load leveling. To date, network reconfiguration and DG placement in distribution networks are considered independently.To the need of adapting energy crisis and climate change, the interconnection of renewable energy generation with the distribution network is increasing rapidly. Wind Turbine (WT) and photovoltaic (PV) generation are the most mature renewable energy resources which attract increasing interests. The objective function is same but additional constraint for placing generator is as follows

Size of installed DG constraint, the total power injection $(\mathrm{Gs})$is not to exceed the total power rating of the generator$(\mathrm{Gd}\ )$in the distribution system

$$\mathrm{Gs} \leq \mathrm{Gd} \quad (7)$$

3.2 DNR with Capacitor in the literature[31-37]

To get added advantage the capacitor is placed after the base network is reconfigured. The objective function here is either single object[31-34] i.e minimization of power loss or maximization of reduction of power lose. In the multi objective function [35-37] are formulated. Traditional and nontraditional optimization techniques are applied to solve the single and multi objective problem and are listed in Table.1. Cost of total energy losses, cost of capacitors and voltage constraint penalty [37], LLI and VDI[36] are added as in objective function. Case wise review from the literature is carried out.

ACSA algorithm is proposed for solving the optimal capacitor placement problem, the optimal feeder reconfiguration problem, and the problem of a combination of the two [31].SPSO algorithm is used to solve the optimal capacitor placement problem, the simulation results indicate that, when simultaneously account both feeder reconfiguration and capacitor placement, the loss reduction is much higher than considering them separately [32]. According to the amount of power loss reduction, the priority of optimization cases is proposed as follows which can be used by utilities to plan their networks optimally: (1) optimal network reconfiguration and capacitor placement are simultaneous; (2) there is network reconfiguration initially, and then capacitor placement follows; and (3) there is capacitor placement initially, and then network reconfiguration follows[33].Percentage of losses when no capacitor bank was installed without DNR is less as compared with Percentage of losses reduced capacitor bank when installed with DNR [34].In fuzzy multi-objective model, the objective functions are reduce cost and improve efficiency of the distribution systems by applying the network reconfiguration and capacitor placement simultaneously. The system cost function involves the overall annual cost of energy losses, customer interruption cost, and that of capacitors to be installed. The operational and power quality constraints such as THD and voltage profile of the network buses are considered to improve the network performance [35].HBBBC algorithm appliedfor multi objective function, the load balancing is included apart from the reduce power losses and to keep voltage profiles within permissible limits in distribution systems, carried out in fuzzy frame [36].The power loss is reduced by network reconfiguration and capacitor placement, which in turn reduces a utility's loss of revenue. To ensure radial structure and avoid islanding of nodes, feasible tie switch combinations are formed prior to the optimization process using a graph theory based MFPA method [37].

3.3 DNR with DGs in the literature[38-51]

Aiming the minimum power loss and increment load balance factor of radial distribution networks with distributed generators with ACS algorithm and demonstrated in particle network of Tia Power Company [38]. Sensitivity analysis is used to identify optimal locations for installation of DG units andnew approach has been proposed to reconfigure and install DG units simultaneously in distribution system [39].DFR is a nonlinear optimization problem; Cuckoo Optimization Algorithm appliedan efficient approach to distribution feeder reconfiguration in presence of DG units. Due to private ownership of DG units, a cost-based compensation method has been used to dispatch DGs [40].

Loss Sensitivity analysis is used to identify optimal location for installation of DG units. It can be observed that more loss reduction can be achieved by the HC-ACO comparing with the other methods when reconfiguration of the feeder is done with installing DG units [41].A composite multi-objective function is formulated to solve the problem which includes: 1. power loss saving, 2. voltage profile, 3. voltage unbalance, and 4. current unbalance of the system. Simultaneous reconfiguration and DG allocation have been carried out in both balanced and unbalanced distribution networks [42].DNR isdone by considering different models of DG using DQPSO technique to minimize the real power losses in the distributed networks where all the open switches defined as a particle and the number of tie switches decides dimensions of particles, so particle dimensions of QPSO with decimal encoding is much smaller than PSO with binary encoding [43]. Sensitivity analysis based on Voltage stability index for optimal location of DG unit where Voltage dependent time varying residential load model is considered with an objective of network reconfiguration was based on real power loss reduction [44]. For objective function are minimize the real powerloss, power loss reduction due to reconfiguration,power loss reduction due to DG installation, sensitivity analysis for DG installation, MC-PCO algorithm used to solve the multi objective problem [45].

In order to take the transient stability of DGs into account, complex optimization problem withreduction of loss, cost and improve transient stability functions are considered as objective functions andEnhanced GSA algorithm is applied [46].The impact of distributed generation and best feeder reconfiguration of distribution system, in order to improve the quality of power in the distribution system is carried out in [47].Distribution network power loss reduction method (only network reconfiguration, only DG installation, DG installation after reconfiguration)results show that simultaneous network reconfiguration and DG installation methods are more effective in reducing power loss and increasing voltage profiles compared to other methods [48].The objectives consist of minimizing power losses and improving the voltage profile, in PSO–ACO based multi-objective optimization algorithm, which takes the advantage of both PSO and ACO optimization method [49].TLBO is a coordinated approach for the optimal allocation of DGs and NR in radial distribution systemscan be extended for the optimal placement of distributed energy resources having intermittent generations [50].

In random fuzzy power output models of distributed generation and load are built based on the random fuzzy theory,corresponding objective functions are established (active power loss and maximum) MPSO algorithm based on Kruskal algorithm is introduced for the first time to determine the optimal network topology [51]

4. DNR with Capacitor placement and DG

Integration of DG with existing distribution networks an increase in voltage if the demand is high, drop in voltage if the demand is high. Active power losses increase with additional increase in DG power. It explains that it is not only select the optimum location of DG but also necessary to select the optimum size. Voltage fluctuations were observed when variable production of DG is integrated to distribution network.DGs in distribution systems can be modelled as PV or PQ modelsTheobjective function is same as that of equation (1) but the constraints are 1.Power flow equations 2. DG penetration level limitation 3.Capacitor penetration level limitation 4.Shunt capacitor constraints 5.Active and reactive power generation constraint of DGs and shunt capacitors6.us voltage limitation 7.Thermal limit 8.Radiality constraint.

4.1 DNR with Capacitor placement DGs in the literature[52-55]

Reconfiguration of a distribution system in the presence of DGs and Shunt Capacitor Banks is proposed to balance the feeder loads and to eliminate overloading conditions. The problem here is formulated as a non-linear optimization problem with an objective function of minimizing the LBI subject to a set of constraints [52].A new simple algorithm presented for solving the distribution network reconfiguration DNR problem.The technique is divided to two steps. First step is to simplify the number of dimensions and search space for each dimension.Second step is to apply the SPSO to choose the optimal branch from each dimension to be opened. The search space for proposed algorithm is a set of branches (switches) which are normally closed or normally opened, this search space may be dissimilar for different dimensions [53].ACO technique, a novel method is proposed for simultaneous dynamic scheduling of DNR and capacitor bank (CB) switching in the presence of DG units having uncertain and variant generations over time. The objective of this method is to minimize the total operational cost of the grid, including the cost of power purchase from the subtransmission substation, cost of customer interruption penalties, Transformers Loss of Life expenses, and the switching costs (CBs and disconnecting switches) [54].In [55] each objective is transferred into fuzzy domain using its membership function. Then, the overall fuzzy satisfaction function is formed and considered a fitness function inasmuch as the value of this function has to be maximized to gain the optimal solution.

5. Discussion and Recommendations

Load balancing, voltage regulation, network reconfiguration and others are different techniques used to reduce the losses.Benefit-to-cost ratio is high for network reconfiguration. DNR is a complex, non-linear, combinatorial, and non differentiable constrained optimization process aimed at finding the radial structure that minimized network power loss while satisfying all operating constraints.DNR

ISSN: 2005-4297 IJCA

is the process of varying the topological arrangement of distribution feeders by changing the open/closed status of sectionalizing and tie switches while respecting system constraints upon satisfying the DSO's objectives.The optimization features from literature review aretabulate in Table.1 and for better understanding classifiedas under

Section A. Network reconfiguration
Section B. Network reconfiguration with then capacitor placement
Section C. Network reconfiguration with DG placement
Section D. Network reconfiguration with optimal capacitor placement, simultaneously

The objective function and constraints are same in all the literatures, minimization of power losses of maximization of reduction of losses in distribution system but the way of approach and implementation may differs with each other. In formulation objective function parameters like voltage variation, load balancing reliability concepts, operational costs, reduction of emissions, improving quality of power etc will also considered for achieve desired results. Multi objective optimization is implanted in DNR with capacitor and DG placement. Nontraditional optimization algorithm is mostly considered for solution of multi objective functions.

From the above discussions and information tabulate inTable.1 it is recommended that:

- Implement DNR with Capacitor and DG sizing and placement simultaneously
- Multi objective Optimization techniques are more effective and the results are near to realistic
- Most of the case studies are carried out on Standard test bus system, need of testing on practical networks
- Suitable algorithms are required for handling the unbalanced distribution network problems.

6. Conclusions

This paper presents the over view of literature review on loss reduction in distribution network with more focus on Reconfiguration. The information reported in the literature in last few years (2008-2018) is collected and summarized. Percentage of losses reduction without DNR is more as compared with Percentage of losses reduced with DNR and is high in DNR with capacitor and DG altogether.Several optimization methodologies are presented to solve single objective and multi objective functions and they have their own potential. Increasing the parameters or indices in the objective function the results are very near to the actual and realistic to the distribution network. In literature there are several nontraditional approaches have been applied to the solution of this problem with varying degrees of success. This work will be helpful to the upcoming research personnel those who are working in this area.

Table 1. Taxonomy of Reviewed papers on Distribution Network Reconfiguration

Reference	Year	Optimizations Features: Loss Reduction	Presence of Capacitor	presence of DG	Economic issues	Emission reduction	Reliability index	Voltage deviation	Load balance/LLI	Load models	Protection Constraints	Comparison	Objective Function(s)	Optimization Method used	Comparison of Results (algorithm/ method)	Test System	Contribution of work
Section: A Distribution Network Reconfiguration alone																	
[1]	2008	x			x								Minimize cost of energy loss	BGA	un deregulated to deregulated system	16-bus test system, 83-bus TPC network	This method could investigate the optimal configuration among various possible configurations and reduced the total energy supply cost with adaptive mutation
[2]	2009	x										x	Minimize active power loss	Heuristic technique	PGSA	IEEE 33-bus system	Heuristic rules are formulated to select optimal switches to reduce power loss
[3]	2009	x											Minimize active power loss	GA	Ref[2]	33-bus test system	Heuristic search methodology used for determining the minimum loss configuration and tree structure identifies the connectivity of the nodes and branches and formation of the loop for radiality of system
[4]	2009	x							x			x	Minimize active power loss	PGSA-Greedy heuristic based fuzzy operation	IMIHDE,EA	33-bus sample system	A new network configuration obtained through the proposed algorithm, by which line loss reduction and load balance can be achieved at once and provides scope for taking up more constraints during optimization
[5]	2010	x										x	Minimize active power loss	MTS	SA, TS	33-node system, 69-node system, 113-node system	The proposed MTS algorithm is better than SA, branch exchange, and TS in large-scale distribution systems. The effect of load variation is taken into consideration and comparative studies to know the effective of

ISSN: 2005-4297 IJCA

											MTS
[6]	2011	x					Minimize active power loss	FAPSO-DE	DPSO, DE	Practical network DS, 11-kV RDS	The fuzzy adaptive particle swarm optimization includes two parts. The first part is fuzzy adaptive binary particle swarm optimization, which determines the status of tie switches , and the second part is fuzzy adaptive discrete particle swarm optimization, which determines the sectionalizing switch number
[7]	2011	x				x	Minimize active power loss	HSA	GA,RGA,ITS	33-bus system, 119-bus system	HSA uses a stochastic random search instead of a gradient search which eliminates the need for derivative information
[8]	2012	x			x	x	Maximize LLI	Heuristic technique (LLI)	GSA, other heuristic techniques	IEEE 33-bus test system	Line loadability index that quantifies the margin to maximum loadability for any distribution line when the sending end voltage is kept constant. This index is simple to use and also guides to compute the extent of load reduction to restore solvability of power flow equations
[9]	2013	x	x	x			Minimize operation cost , Minimize(loss ENS)	EGSA	GA, PSO	IEEE 33-bus test system	The proposed approach considers reliability, operation cost and loss simultaneously. This paper utilises a Pareto-based approach which can obtain a set of optimal solutions instead of one
[10]	2013	x	x	x			Minimize power losses , Minimize interruptions costs	NDSGA II	-	35 kV RDS	Multi objective problem is formulated with intention to reduce total losses in the network and improve system reliability through minimization of total costs incurred due to power supply interruptions
[11]	2014	x					Minimize active power loss	ACSO	ABC Algorithm, SA, DE,GA	IEEE 14-bus test system	The ACS methodology has the following characteristics like Positive feedback, Distributed computation, Greedy heuristic which makes the ACS algorithm to be the best

																	suitable method for network reconfiguration
[12]	2014	x										x	Minimize active power loss	ABCA	RGA, TSA	IEEE 33-bus test system	ABC is developed based on inspecting the behaviors of real bees to find nectar and sharing the information of food sources to the bees in the hive
[13]	2014	x											Minimize active power loss	Catfish PSO algorithm	RGA, ACSA, BFOA, AGA	16-bus RDS, 33-bus RDS	The catfish PSO algorithm was proposed in this paper to configure the distribution network to keep the load balance so that the power loss was minimum
[14]	2014	x					x						Minimize active power lossMinimize (SAIFI+SAIDI+ENS)	PEM	DPSO, DPSO–HBMO, MHBMO	Baran and Wu 32 -bus RDS	A new stochastic framework based on PEM and MCSA is proposed to investigate the constructive consequence of optimal reconfiguration on the reliability of the distribution systems including SAIFI, SAIDI and AENS.
[15]	2014	x						x				x	Minimize (power loss + voltage deviation I)	Meta-heuristics FWA	GA, RGA, ITS, HSA	33-bus test system, 119-bus test system	FWA is a recently developed swarm intelligence based optimization algorithm . Under abnormal conditions, the proposed method will isolate the faulted areas and assures power supply to the non-faulted areas of the system with minimum voltage deviation and load shedding.
[16]	2015	x						x				x	Minimize active power loss Maximize voltage magnitude	CSA	PSO, CGA, FWA, GA, RGA, ITS, HAS, IAICA	33-node system, 69-node system, 119-node system	In comparison with other meta-heuristic search algorithms, the CSA is an efficient population-based heuristic evolutionary algorithm for solving optimization problems with the advantages of simple implementation procedure and few control parameters.
[17]	2015	x					x						Minimize active power loss Maximize reliability	EGA	GA, Power flow approximation method	33-bus test system, 69-bus test system, 136-bus test system,	The network reconfiguration problem for loss reduction and reliability improvement is formulated to be solved by using enhanced GA to radial distribution systems, the procedure described is also valid for meshed systems too

[18]	2015	x					x					x	Minimize active power loss Minimize ENS	NDSAC	NSACO, PESA2	IEEE 16 -bus test system, IEEE 33-bus test system	In obtaining a single solution between pareto front points, a heuristic way that is used in this paper is applying another objective function separately for all obtained
[19]	2016	x											Minimize active power loss	BFOA	RGA, ACS, GA	IEEE 33-bus system	A bacterial foraging optimization algorithm is proposed in this paper is to configure distribution network to keep the load balancing so that the power loss is minimum
[20]	2016	x										x	Minimize active power loss	BFOA	HAS,RGA	33-bus RDS	BFOA is used to obtain the optimal switching configuration which results in a minimum loss, BFS is used to optimize the deviation in node voltages, and GIS is used for planning and easy analysis purposes
[21]	2016	x										x	Minimize active power loss	BBOA	GA ,RGA ,HAS	33- bus RDS	BBO algorithm is proposed to solve the problem of reconfiguration with different switching combinations and has some common characteristics with genetic algorithm and Particle swarm optimization
[22]	2016	x										x	Constraints of voltage and branch current carrying capacity	Meta-heuristic PSO	Before and after reconfigure	IEEE 33-bus test system, IEEE 69-bus test system	A Meta-heuristic Particle swarm optimization (PSO) is used to reconfigure and recognize the optimal tie switches for reduction of real power loss in a radial distribution system. The constraints of voltage and branch current carrying capacity are incorporated in the assessment of the objective function
[23]	2016	x						x			x		Active power loss Voltage profile index with Protection constraints	GA	PSO,CSO,FWA	IEEE 33-bus test system, IEEE 69-bus test system, IEEE 119-bus test system	Reconfiguration problem considering protective constraints. Protective constraints consist of 1.operating constraints such as relays, reclosers and fuses of the distribution network in the normal and fault conditions.2. coordination of the protective devices
[24]	2016	x											Minimize active power loss	hybrid algorithm PSO+TS	BPSO,PSO, Hybrid-TS	IEEE 33	The main contribution of this paper is presenting a hybrid PSO searching algorithm and introduces NRK as the tree representation

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																	strategy for the new algorithm., NRK is not very sensitive to PSO algorithm, and that is also the very reason why algorithms with strong local search ability like tabu search are indispensable
[25]	2017	x										x	Minimize active power loss	DFA	Before and after reconfigure	IEEE 16-bus test system, IEEE 33-bus test system, IEEE 69-bus test system	The Dragonfly algorithm starts optimization process by creating a set of random solutions for a given optimization problem. In each iteration, the position and step of each dragonfly are updated and the position updating process is continued iteratively until the convergence criterion is satisfied
[26]	2017	x											Minimize active power loss	NMPC	with and with out DG	Network of Croatia (operator HEP-ODS)	Application of a nonlinear model predictive control algorithm to the problem of dynamic reconfiguration of an electrical power distribution system with distributed generation and storage
[27]	2017	x					x						Minimize active power loss Minimize (Reliablity Indices)	ICA	PSO,SFLA,ISFLA,ICA, HBMO,	IEEE 33-bus test system, IEEE 69-bus test system	Objective functions have different scales, a fuzzy membership is utilized here to transform objective functions into a same scale and then to determine the satisfaction level of the afforded solution using the fuzzy fitness
[28]	2017	x										x	Minimize active power loss	MSPO	BPSO,MCPSO , SPSO,MPSO	IEEE 33-bus test system, IEEE 69-bus test system	Filtered random selective search space for initial position, which is proposed to accelerate the algorithm for reaching the optimum solution.
[29]	2017	x										x	Minimize active power loss	UMPSO	Base case ,GA , PSO, PIPSO	IEEE 33-bus test system, IEEE 69-bus test system	The network active power loss is picked as the minimization problem, and it is diminished by executing optimum feeder reconfiguration in radial power distribution system using unified particle swarm optimization algorithm and system power loss is handled as the cost function for every particle in a swarm

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[30]	2018	x			x								Minimize active power loss	MVO	SCA,ALO,GWO,MFO	16-node System, 69-node System	The MVO technique has been applied to network reconfiguration to reduce power loss and maximum reduction in emissions by means of step by step switching
Section:B Distribution Network Reconfiguration with Capacitor placement																	
[31]	2008	x	x									x	Minimize active power loss	ACSA	GA, SA	16-bus distribution system, 83-bus TPC network	Simultaneously taking into account both feeder reconfiguration and capacitor placement is more effective than considering only one at a time
[32]	2013	x	x										Maximize the loss reduction	SPSO	GA, SA, ACSA	16-bus distribution system, 83-bus TPC network	Simultaneous capacitor placement and DNR is more effective than considering them separately
[33]	2014	x	x			x						x	Minimize active power loss	Improved BPSO	GA, SA, ACSA,ACO	IEEE 16-bus test system, IEEE 33-bus test system	The proposed model uses binary strings which represent the state of the network switches and capacitors. Amount of emission reduction due to reduction of energy losses in the test networks
[34]	2014	x	x									x	Minimize active power loss	GA	With and without capacitor	IEEE 33-bus system	There are a number of normally open (NO) and normally closed (NC) switches in the network, which can be employed for the reconfiguration of the distribution network to achieve the lowest distribution losses
[35]	2015	x	x		x					x		x	Minimize cost (energy losses, interruption cost, capacitors installation) improvement (THD and voltage profile)	BGSA	BPSO, BGA	IEEE 33-bus test system, 83-bus TPC network	A fuzzy multi-objective model used to reduce cost and improve efficiency of the distribution systems by applying the network reconfiguration and capacitor placement simultaneously. The cost function comprises the overall annual cost of the energy loss, ECOST, and shunt capacitors to be installed
[36]	2016	x	x				x		x			x	Minimize active power loss Minimize Bus VDI	HBBBC	PSO, BPSO, ACO, SA, GA , ACSA	Baran and Wu 32 -bus RDS, 25 bus unbalanced network	An important property of the proposed approach is solving the multi-objective reconfiguration and capacitor placement problem in the fuzzy framework.

													Minimize of LBI			94-bus test system	
[37]	2016	x	x		x			x				x	Min (cost of total energy losses + cost of capacitors + voltage constraint penalty)	MFPA	SA, HSA , IBPSO	33-bus test system 69-bus test system 118-bus test system	The modified flower pollination algorithm uses a flower pollination process, an improved local neighborhood search method, and a dynamic switching probability approach to enhance the global search for optimization
[38]	2010	x		x					x				Minimize active power loss Improve Load balancing	ACS	GA, AS	33-bus test system, 83-bus TPC network	The three rules make the ACS become an extremely powerful method for optimization problems they are state transition rule, local updating rule and global updating rule. DG has the improvement effects on loss reduction and can increase the system balancing index
Section:C.Distribution Network Reconfiguration with DG																	
[39]	2013	x		x								x	Maximize loss reduction (reconfiguration + DG)	HSA	GA, RGA	IEEE 33-bus test system, IEEE 69-bus test system	Simultaneous network reconfiguration and DG installation method is more effective in reducing power loss and improving the voltage profile compared to other methods. Network is simulated at 3 load levels (light, normal and heavy)
[40]	2014	x		x	x								Minimize cost (DGs+DSO) Minimize (switching operations+ voltage deviation)	COA	GA,TS	31 -bus test system	Since the tie and sectionalizing switches and DG units are non-differentiable and nonlinear, respectively, the distribution feeder reconfiguration problem is conventionally considered a mixed-integer nonlinear programming problem
[41]	2014	x		x								x	Minimizes active power lossMinimizes VDI	HCACO	HAS,GA,RGA	33- bus RDS	HC-ACO is a constructive and greedy search approach that make use of positive feedback such as the gradient information of the objective function as well as pheromone trails and heuristic information that guide the search

													and lead to rapid discovery of good solutions.
[42]	2014	x	x			x			Maximize Loss reduction Minimize Voltage violations Less Voltage unbalance Less Current unbalance	GA	SPSO,HAS,TS, GA,ACA, MHBMO,HSA	IEEE 33-bus test system, IEEE 69-bus test system, IEEE 25-bus unbalanced system	Composite multi-objective function is formulated to solve the problem which includes: 1. power loss saving, 2. voltage profile, 3. voltage unbalance, and 4. current unbalance of the system
[43]	2015	x	x						Minimizes active power loss	DCQPSO	GA,DPSO,BPSO	IEEE 33-bus test system, 69-bus PG&E network	Proposed objectives function for optimizing the size of the DG unit using genetic algorithm. Sensitivity analysis based on voltage stability index for optimal location of DG unit. Voltage dependent time varying residential load model is considered
[44]	2016	x	x				x	x	Optimal location and size of DG Improve voltage profile Minimizes active power loss	GA	Base network and DNR With and with out DG unit	IEEE 33-bus system	Proposed objectives function for optimizing the size of the DG unit using genetic algorithm. Sensitivity analysis based on voltage stability index for optimal location of DG unit.Voltage dependent time varying residential load model is considered
[45]	2016	x	x						Minimizes active power loss Maximize loss reduction (reconfiguration + DG) Minimizes	MC-PSO	HAS, GA, RGA	IEEE 33-bus test system, IEEE 69-bus test system	The problem of repeated load flows while calculating the sensitivity factors has been avoided by using the exact loss formula

										Sensitivity with DG				
[46]	2016	x	x	x						Minimizes active (power loss operation costs) Improve the transient stability	Enhanced GSA	GA,PSO	33- bus test system	DFR problem has been solve by EGSA to improve the transient stability index and decrease losses and operation cost in a distribution test system with multiple micro-turbines
[47]	2016	x	x						x	Minimizes active power loss	HGAPSO	DNR With and without DG unit	IEEE 33-bus system	The hybrid of GA and PSO named as HGAPSO and this algorithm consists of four major operators: enhancement, selection, crossover, and mutation
[48]	2017	x	x				x			Minimizes active power loss Maximize the voltage profile	Multi-objective GA	Optimal non dominated solutions	IEEE 69-bus system	Simultaneous network reconfiguration and DG installation methods are more effective in reducing power loss and increasing voltage profiles compared to other methods
[49]	2017	x	x			x			x	Minimize active power loss Minimize voltage deviation	Hybrid PSO–ACO algorithm	HAS	IEEE -33 bus system	ACO is incorporated in basic PSO to improve exploration power of algorithm to examine much more solutions. One of the main pivotal features of this paper is investigating the impact of distribution generation units on DSR problem
[50]	2017	x	x					x	x	Optimize size, and location of DG simultaneously	ISBTLBO	HAS,GA,RGA,FWA,EP,TBLO	IEEE 33-bus test system, IEEE 69-bus test system, IEEE 83-bus test system	IS directs optimization techniques to efficiently scan the problem search space in such a way that a fair candidature is available to all decision variables of the problem
[51]	2018	x	x						x	Minimize active power loss Minimize voltage	MPSO	GA,PSO,MPSO without transposition	IEEE 33-node system, PG&E 69- bus systems,	Fuzzy power output models of distributed generation and load are built, corresponding objective functions are established (power loss and maximum probability of voltage limit)

													deviation			25 -bus unbalanced system 109 -bus test system	then to determine the optimal network topology with Krusal algorithm
Section:D Distribution Network Reconfiguration with Capacitor placement and DG																	
[52]	2014	x	x	x					x				Minimizes active power loss Minimize LBI	PSO	TS	IEEE 69-bus system	The problem here is formulated as a non-linear optimization problem with an objective function of minimizing the Load Balancing Index (LBI) subject to a set of constraints
[53]	2016	x	x	x								x	Minimize active power loss	SPSO	Before and after reconfiguration With and without DG and capacitor	IEEE -33 bus system	The technique is divided to two steps. First step is to simplify the number of dimensions and search space for each dimension. Second step is to apply the SPSO to choose the optimal branch from each dimension to be opened
[54]	2017	x	x	x	*x*		*x*			x		x	Minimize cost of (electric energy + interruption penalty cost + loss of life cost of transformer and switching equipment)	ACO + HS	Before and after reconfiguration With and without DG and capacitor	IEEE 118-bus test system	It is proposed to determine the optimum distribution system configuration and reactive power of capacitor banks for each interval of the planning period and in order to reduce the complexity of the problem, a case reduction technique using HS algorithm was proposed
[55]	2017	x	x	x				x	x			x	Minimize power loss (reconfiguration + DG + shunt capacitors) Minimum voltage deviation Improving LBI	Fuzzy-BFO	Fuzzy -GA, Fuzzy-PSO,IPSO	IEEE 33-bus test system, IEEE 69-bus test system	Each objective is transferred into fuzzy domain using its membership function. Then, the overall fuzzy satisfaction function is formed and considered a fitness function inasmuch as the value of this function has to be maximized to gain the optimal solution

References

[1] H. K. Kargar, S. Jalilzadeh, A. Rezazadeh, V. Nabi and G. Z. Govar, "Reconfiguration of deregulated distribution network for minimizing energy supply cost by using BGA," 2008 43rd International Universities Power Engineering Conference, Padova, 2008, pp. 1-5. https://doi.org/10.1109/UPEC.2008.4651545

[2] R. S. Rao, S. V. L. Narasimham, "A new heuristic approach for optimal network reconfiguration in distribution systems", Int. J. Appl. Sci. Eng. Technol., vol. 5, pp. 15-21, 2009.

[3] E.Dolatdar, S.Soleymani, B.Mozafari, A New Distribution Network Reconfiguration Approach using a Tree Model ,International Journal of Computer, Electrical, Automation, Control and Information Engineering Vol:3, No:10, 2009

[4] S. Thiruvenkadama , A. Nirmalkumarb , and M. Sathiskumar, Distribution Network Optimization through Algorithm Design Techniques, GESTS Int’l Trans. Computer Science and Engr., Vol.57, No.1,131-148,2009, https://www.researchgate.net/publication/235657084

[5] A.Y. Abdelaziz ∗, F.M. Mohamed, S.F. Mekhamer, M.A.L. Badr, Distribution system reconfiguration using a modified Tabu Search algorithm, Electric Power Systems Research, Volume 80, Issue 8, August 2010, Pages 943-953, https://doi.org/10.1016/j.epsr.2010.01.001

[6] TaherNiknam, Ehsan Azad Farsani, MajidNayeripour&BahmanBahmaniFirouzi (2011) Hybrid Fuzzy Adaptive Particle Swarm Optimization and Differential Evolution Algorithm for Distribution Feeder Reconfiguration, Electric Power Components and Systems, 39:2, 158-175, DOI: 10.1080/15325008.2010.526990

[7] R. SrinivasaRao, S. V. L. Narasimham, M. RamalingaRaju and A. SrinivasaRao, "Optimal Network Reconfiguration of Large-Scale Distribution System Using Harmony Search Algorithm," in IEEE Transactions on Power Systems, vol. 26, no. 3, pp. 1080-1088, Aug. 2011, https://doi.org/10.1109/TPWRS.2010.2076839

[8] K. Nagaraju , S. Sivanagaraju , T. Ramana , V. Ganesh, Heuristic Approach for Distribution Systems Feeder Reconfiguration to Line Maximum Loadability, International Journal on Electrical Engineering and Informatics - Volume 4, Number 1, March 2012

[9] Mohammad RasoulNarimani, Ali Azizi Vahed1, RasoulAzizipanah-Abarghooee, MahshidJavidsharifi, Enhanced gravitational search algorithm for multi-objective distribution feeder reconfiguration considering reliability, loss and operational cost, IET Gener. Transm.Distrib., pp. 1–15, https://doi.org/10.1049/iet-gtd.2013.0117

[10] Amir Nuhanovi´c— JasnaHivziefendi´c, Amir Hadzimehmedovi´c, Distribution network reconfiguration considering power losses and outage costs using genetic algorithm, Vol. 64, No. 5, 2013, 265–27, https://doi.org/10.2478/jee-2013-0039

[11] ShabanaMehfuz& Farah Rashid (2014), Ant colony system algorithm for optimal network reconfiguration, International Journal of Computational Intelligence Systems, 7:5, 973-978, https://doi.org/10.1080/18756891.2014.960235

[12] S. Ganesh, Network Reconfiguration of Distribution System Using Artificial Bee Colony Algorithm, International Scholarly and Scientific Research & Innovation 8(2) 2014,396-402 http://scholar.waset.org/1999.5/9997973

[13] Kumar, K.S., Naveen, S. Power system reconfiguration and loss minimization for a distribution systems using “Catfish PSO” algorithm. Front. Energy 8, 434–442 (2014). https://doi.org/10.1007/s11708-014-0313-y

[14] A. Kavousi-Fard, T. Niknam, M. Akbari-Zadeh and B. Dehghan, "Stochastic framework for reliability enhancement using optimal feeder reconfiguration," in Journal of Systems Engineering and Electronics, vol. 25, no. 5, pp. 901-910, Oct. 2014. https://doi.org/10.1109/JSEE.2014.00104

[15] A. Mohamed Imran, M. Kowsalya,A new power system reconfiguration scheme for power loss minimization and voltage profile enhancement using Fireworks Algorithm,International Journal of Electrical Power & Energy Systems,Volume 62,2014,Pages 312-322,ISSN 0142-0615, https://doi.org/10.1016/j.ijepes.2014.04.034.

[16] ThuanThanh Nguyen, Anh Viet Truong,Distribution network reconfiguration for power loss minimization and voltage profile improvement using cuckoo search algorithm,International

Journal of Electrical Power & Energy Systems,Volume 68,2015,Pages 233-242,ISSN 0142-0615, https://doi.org/10.1016/j.ijepes.2014.12.075.
[17] Dong-Li Duan, Xiao-Dong Ling, Xiao-Yue Wu, Bin Zhong,Reconfiguration of distribution network for loss reduction and reliability improvement based on an enhanced genetic algorithm,International Journal of Electrical Power & Energy Systems,Volume 64,2015,Pages 88-95,ISSN 0142-0615,https://doi.org/10.1016/j.ijepes.2014.07.036.
[18] SeyedHasanMirhoseini, Seyed Mehdi Hosseini, Mehdi Ghanbari, and MajidGandomkar, Multi-objective Reconfiguration of Distribution Network Using a Heuristic Modified Ant Colony Optimization Algorithm, Journal of Modeling & Simulation in Electrical & Electronics Engineering (MSEEE), Volume 1: (1), Feb. 2015,pp.23-28, https://dx.doi.org/10.22075/mseee.2015.239
[19] K. Sathish Kumar, T. Jayabarathi,Power system reconfiguration and loss minimization for an distribution systems using bacterial foraging optimization algorithm,International Journal of Electrical Power & Energy Systems,Volume 36, Issue 1,2012,Pages 13-17,ISSN 0142-0615,https://doi.org/10.1016/j.ijepes.2011.10.016.
[20] Manju Mam , Leena G a , N.S. Saxena, Distribution Network Reconfiguration for Power Loss Minimization Using Bacterial Foraging Optimization Algorithm, I.J. Engineering and Manufacturing, 2016, 2, 18-32, https://doi.org/10.5815/ijem.2016.02.03
[21] B. Y. Bagde, B. S. Umre, R. D. Bele and H. Gomase, "Optimal network reconfiguration of a distribution system using Biogeography Based Optimization," 2016 IEEE 6th International Conference on Power Systems (ICPS), New Delhi, 2016, pp. 1-6. https://doi.org/10.1109/ICPES.2016.7584114
[22] A. V. S. Reddy and M. D. Reddy, "Optimization of network reconfiguration by using Particle swarm optimization," 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), Delhi, 2016, pp. 1-6. https://doi.org/10.1109/ICPEICES.2016.7853268
[23] B. Khorshid-Ghazani, H. Seyedi, B. Mohammadi-ivatloo, K. Zare, S. Shargh, Reconfiguration of distribution networks considering coordination of the protective devices, IET Generation, Transmission & Distribution Volume 11, Issue 1, 05 January 2017, p. 82 – 92, https://doi.org/10.1049/iet-gtd.2016.0539
[24] Sidun Fang, Xiaochen Zhang, A Hybrid Algorithm of Particle Swarm Optimization and Tabu Search for Distribution Network Reconfiguration, Mathematical Problems in Engineering, Volume 2016, Article ID 7410293, 7 pages, http://dx.doi.org/10.1155/2016/7410293
[25 A. V. Sudhakara Reddy, Prof M. Damodar Reddy, Optimization of distribution network reconfiguration using dragonfly algorithm, Journal of Electrical Engineering, 2016.
[26] BranimirNovoselnik, Martin Bolfek, Marin Bošković, MatoBaotić,Electrical Power Distribution System Reconfiguration: Case Study of a Real-life Grid in Croatia IFAC-PapersOnLine,Volume 50, Issue 1,2017,Pages 61-66, https://doi.org/10.1016/j.ifacol.2017.08.011.
[27] Sedighizadeh M, Esmaili M, Mahmoodi M M. Reconfiguration of distribution systems to improve reliability and reduce power losses using Imperialist Competitive Algorithm. IJEEE. 2017; 13 (3) :287-302, http://dx.doi.org/10.22068/IJEEE.13.3.6
[28] I. I. Atteya, H. Ashour, N. Fahmi and D. Strickland, "Radial distribution network reconfiguration for power losses reduction using a modified particle swarm optimization," in CIRED - Open Access Proceedings Journal, vol. 2017, no. 1, pp. 2505-2508, 10 2017. https://doi.org/10.1049/oap-cired.2017.1286
[29] DhanavijayanRamakrishnan, SudhakarPushparajan, Unified particle swarm optimization based feeder reconfiguration for radial distribution system,, International Journal of Pure and Applied Mathematics, Volume 117 No. 21 2017, 953-959
[30 Reddy, A. V., Damodar Reddy, M., & Reddy, Y. V. (2018). Feeder Reconfiguration of Distribution Systems for Loss Reduction and Emissions Reduction Using MVO Algorithm. Majlesi Journal of Electrical Engineering, 12(2), 1-8
[31] C. Chang, "Reconfiguration and Capacitor Placement for Loss Reduction of Distribution Systems by Ant Colony Search Algorithm," in IEEE Transactions on Power Systems, vol. 23, no. 4, pp. 1747-1755, Nov. 2008. https://doi.org/10.1109/TPWRS.2008.2002169

[32] T.M. Khalil, A.V. Gorpinich, G.M. Elbanna, Combination of capacitor placement and reconfiguration for loss reduction in distribution systems using selective PSO, 22nd International Conference on Electricity Distribution Stockholm, 10-13 June 2013, Paper 0078, https://doi.org/10.1049/cp.2013.0553

[33] Sedighizadeh, M., Dakhem, M., Sarvi, M. et al., Optimal reconfiguration and capacitor placement for power loss reduction of distribution system using improved binary particle swarm optimization. Int J Energy Environ Eng 5, 3 (2014). https://doi.org/10.1186/2251-6832-5-3

[34] A. Rouhani, R. M. Habib, A. G. Morteza, "Reconfiguration of Distribution Network Based on a Genetic Algorithm for loss Reduction Considering Capacitor Placement", Current Trends in Technology and Science, no. 18, 2014.

[35] Hamid Reza Esmaeilian, RoohollahFadaeinedjad,Distribution system efficiency improvement using network reconfiguration and capacitor allocation,International Journal of Electrical Power & Energy Systems,Volume 64,2015,Pages 457-468,ISSN 0142-0615,https://doi.org/10.1016/j.ijepes.2014.06.051.

[36] MostafaSedighizadeh, Reza Bakhtiary,Optimal multi-objective reconfiguration and capacitor placement of distribution systems with the Hybrid Big Bang–Big Crunch algorithm in the fuzzy framework,Ain Shams Engineering Journal,Volume 7, Issue 1,2016,Pages 113-129,ISSN 2090-4479, https://doi.org/10.1016/j.asej.2015.11.018.

[37] GnanasekaranNamachivayam, ChandramohanSankaralingam, Sathish Kumar Perumal&SudhakarThirumalaivasalDevanathan (2016) Reconfiguration and Capacitor Placement of Radial Distribution Systems by Modified Flower Pollination Algorithm, Electric Power Components and Systems, 44:13, 1492-1502, https://doi.org/10.1080/15325008.2016.1172281

[38] Y. Wu, C. Lee, L. Liu and S. Tsai, "Study of Reconfiguration for the Distribution System With Distributed Generators," in IEEE Transactions on Power Delivery, vol. 25, no. 3, pp. 1678-1685, July 2010. https://doi.org/10.1109/TPWRD.2010.2046339

[39] R. S. Rao, K. Ravindra, K. Satish and S. V. L. Narasimham, "Power Loss Minimization in Distribution System Using Network Reconfiguration in the Presence of Distributed Generation," in IEEE Transactions on Power Systems, vol. 28, no. 1, pp. 317-325, Feb. 2013. https://doi.org/10.1109/TPWRS.2012.2197227

[40] MohamadAmiri, Mina SheikholeslamiKandelousi, and MahmoodMoghadasian, Distribution Feeder Reconfiguration Considering Distributed Generators using Cuckoo Optimization Algorithm, 2nd International Conference on Research in Science, Engineering and Technology (ICRSET'2014), March 21-22, 2014 Dubai (UAE), http://dx.doi.org/10.15242/IIE.E0314577

[41] ManasRanjanNayak, Optimal Feeder Reconfiguration of Distribution System with Distributed Generation Units using HC-ACO, International Journal on Electrical Engineering and Informatics - Volume 6, Number 1, March 2014,107-128, http://dx.doi.org/10.15676/ijeei.2014.6.1.8

[42] Seyed Abbas Taher, Mohammad HosseinKarimi,Optimal reconfiguration and DG allocation in balanced and unbalanced distribution systems,Ain Shams Engineering Journal,Volume 5, Issue 3,2014,Pages 735-749,ISSN 2090-4479,https://doi.org/10.1016/j.asej.2014.03.009.

[43]Wanlin Guan, Yanghong Tan, Haixia Zhang, JianliSong,Distribution system feeder reconfiguration considering different model of DG sources,International Journal of Electrical Power & Energy Systems,Volume 68,2015,Pages 210-221,ISSN 0142-0615, https://doi.org/ 10.1016/j.ijepes. 2014.12 .023.

[44] S. Das, D. Das and A. Patra, "Distribution network reconfiguration using distributed generation unit considering variations of load," 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), Delhi, 2016, pp. 1-5. https://doi.org/10.1109/ICPEICES.2016.7853481

[45] S. Jena and S. Chauhan, "Solving distribution feeder reconfiguration and concurrent dg installation problems for power loss minimization by multi swarm cooperative PSO algorithm," 2016 IEEE/PES Transmission and Distribution Conference and Exposition (T&D), Dallas, TX, 2016, pp. 1-9. https://doi.org/10.1109/TDC.2016.7520021

[46] EsmaeilMahboubi-Moghaddam, Mohammad RasoulNarimani, Mohammad Hassan Khooban, Ali Azizivahed, MahshidJavidsharifi,Multi-Objective Distribution feeder reconfiguration to improve transient stability, and minimize power loss and operation cost using an enhanced evolutionary algorithm at the presence of distributed generations,International Journal of Electrical Power & Energy Systems,Volume 76,2016,Pages 35-43,ISSN 0142-0615,https://doi.org/10.1016/j.ijepes.2015.09.007.

[47] ArifWazir, NaeemArbab, Analysis and Optimization of IEEE 33 Bus Radial Distributed System Using Optimization Algorithm, (JETAE) Journal of Emerging Trends in Applied Engineering (ISSN 2518-4059), Vol. 1, No. 2, 2016, https://pdfs.semanticscholar.org/dcf9/2a2d6e5d96678031f313b8a78b6d8e4fdd3e.pdf

[48] RamadoniSyahputra, Distribution Network Optimization Based on Genetic Algorithm, Journal of Electrical Technology UMY (JET-UMY), Vol. 1, No. 1, March 2017

[49] M. Amin Heidari, "Optimal network reconfiguration in distribution system for loss reduction and voltage-profile improvement using hybrid algorithm of PSO and ACO," in CIRED - Open Access Proceedings Journal, vol. 2017, no. 1, pp. 2458-2461, 10 2017. https://doi.org/10.1049/oap-cired.2017.1007

[50] NeerajKanwar, Nikhil Gupta, Khaleequr R. Niazi& Anil Swarnkar (2017) Optimal Allocation of DGs and Reconfiguration of Radial Distribution Systems Using an Intelligent Search-based TLBO, Electric Power Components and Systems, 45:5, 476-490, DOI: 10.1080/15325008.2016.1266714

[51] H. Wu, P. Dong and M. Liu, "Distribution Network Reconfiguration for Loss Reduction and Voltage Stability with Random Fuzzy Uncertainties of Renewable Energy Generation and Load," in IEEE Transactions on Industrial Informatics. https://doi.org/10.1109/TII.2018.2871551

[52] G. Balakrishna , Dr. Ch. SaiBabu, Particle Swarm Optimization based Network Reconfiguration in Distribution System with Distributed Generation and Capacitor Placement, The International Journal Of Engineering And Science (IJES), Volume :3(12), December – 2014,Pages: 55-60ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

[53] P. K. , S. (2016). Network Reconfiguration Of Distribution System Using Particle Swarm Optimization. International Journal of Engineering and Computer Science, 5(8). Retrieved from http://103.53.42.157/index.php/ijecs/article/view/2080

[54] Amir Ameli, Amir Ahmadifar, Mohammad-HosseinShariatkhah, Mehdi Vakilian, Mahmoud-Reza Haghifam,A dynamic method for feeder reconfiguration and capacitor switching in smart distribution systems, International Journal of Electrical Power & Energy Systems,Volume 85,2017,Pages 200-211,ISSN 0142-0615,https://doi.org/10.1016/j.ijepes.2016.09.008.

[55] Mohammadi, M., Rozbahani, A.M. &Bahmanyar, S. Power loss reduction of distribution systems using BFO based optimal reconfiguration along with DG and shunt capacitor placement simultaneously in fuzzy framework. J. Cent. South Univ. 24, 90–103 (2017).https://doi.org/10.1007/s11771-017-3412-1